1976

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AR42

BACKGROUND INFORMATION ON THE MEDICAL USES OF THE SILICONES

The element silicon is one of the most common elements on earth. The earth's crust is 25 percent silicon down to a depth of 10 miles. Most people are aware of silicon in the form of sand and ordinary glass. Silicon is rarely seen in its pure form, however. It is usually found in combination with oxygen in a compound which chemists call silicon dioxide, or silica, the main component of ordinary sand.

Silicon compounds are characteristically inert, unchanging material. As tough chemical cousins of glass and granite, they resist change when subjected to other chemicals and are unaffected by high and low temperatures. They are also good electrical insulators.

Carbon, on the other hand, is an element which has the unique property of being able to form a wide variety of materials. Carbon atoms can be joined together and combined with other atoms in an infinite variety of molecular structures to produce substances with varied chemical and physical properties. Thus, gasoline and an ordinary plastic are both carbon compounds.

(MORE)

Unlike the inert silicon compounds, carbon compounds are subject to change under extremes of temperature. They are attacked by many chemicals and, under certain conditions, will decompose and burn or freeze. The study of carbon and its compounds has become an entire field of chemistry on its own in modern times. It is known as organic chemistry.

As a result of our increased understanding of carbon or organic chemistry over the past half-century, chemists have been able to build carbon atoms in the long molecular chains needed to give plastic properties to a material. It is only in the world of organic chemistry that we find soft and rubbery materials.

Suppose it were possible to combine the inert, glass-like properties of the silicon materials with the softness of some of the carbon compounds? The result might be a new material that would be plastic by virtue of its organic constituents yet still retain some of the great stability and chemical inertness so characteristic of inorganic compounds.

Although the idea of combining silicon and carbon is more than a hundred years old, it wasn't until the early part of this century that chemists actually succeeded in producing "silicone" (silicon and carbon) compounds. At first, these materials were nothing more than laboratory curiosities. But then, as chemists learned more about their many unusual properties, industrial applications began to appear. Soon, silicone compounds were being developed with custom-designed molecules to meet specific needs.

(MORE)

The first practical silicone material was a resin for use in an electrical insulating varnish. That was in 1943, and military needs for special silicone compounds received top priority. The Dow Corning Corporation, a joint venture of The Dow Chemical Company and the Corning Glass Works, was organized to produce silicone products for the war effort. These early items were silicone fluids and greases. In 1945, the development of a silicone rubber was announced. The commercial applications for silicone materials multiplied almost overnight.

At the end of World War II, the fact that water would not cling to a glass surface after it had been coated with silicones was used to insure complete drainage of penicillin bottles. It was also found that blood did not clot as quickly in contact with siliconized glass as untreated glass. Other medical applications for silicones appeared practical.

The increasing interest on the part of medical researchers in silicones presented somewhat of a problem for the new Dow Corning Company. Silicone materials made for medical research were already saving lives that had previously been lost, and correcting impediments that had been uncorrectable. But the company knew practically nothing about the medical field and was totally unprepared to meet its special needs.

In 1959, Dow Corning's Board of Directors decided to accept the cost of what it believed to be its social obligation by establishing the Dow Corning Center for Aid to Medical Research. The Center was to act as a clearing house for all information on the medical uses of the silicones. It would also supply

researchers with samples of silicone fluids, resins, tubing, blocks and simple molded parts upon request. If any devices were developed which were needed in larger quantities than the labs could supply, the Center would try to find a suitable fabricator. All of this was done without cost to the researcher.

Since its establishment, the Center has corresponded with more than 35,000 physicians and researchers in all areas of medicine. Its library of reprints on the medical uses of the silicones has grown from the original 30 papers to approximately 4,000. The Center carries on no active research of its own, but works closely with researchers in providing the data and materials they need.

Finding suitable fabricators to produce medical devices made from silicone materials in quantity, however, proved to be quite difficult. Since, figuratively speaking, it was only a short distance from the laboratory to the factory, manufacturing personnel needed the constant support of the research team in solving a constant stream of fabrication problems. Few fabricators were prepared to make the enormous investment needed to manufacture medical quality silicone products. Therefore, in 1962, Dow Corning established its Medical Products Division to manufacture, distribute and market medical-grade silicones and devices made from them.

The basis for most medical applications for the silicones lies, again, in the fact that they combine the inertness of silicon with the softness of many organic carbon compounds. Early in this century, metals technology had developed

some alloys which were inert enough to permit implantation in the human body for long periods of time. Their use, unfortunately, was limited to bone repair and replacement. What was needed, of course, was a replacement for soft tissue. Since soft tissue is constantly in motion, any contact with hard implants can result in tissue erosion. Soft materials, on the other hand, were equally unsuitable. The body rejects foreign animal and vegetable tissues even more swiftly than it does metal. Also, most organic implants deteriorated very rapidly once placed inside the body.

Soft silicone materials have been shown to be excellent for tissue replacement applications for a number of reasons. These include:

1. Medical-grade silicones cause minimal tissue reaction.

2. There is no record of metabolism of a silicone by any living organism.

3. They can be compounded to simulate the textures of many different tissues, from the softness of fatty tissues to hardness of bone, as witnessed by the Silastic Mammary Prosthesis and the Silastic Finger Joint Implant, both from Dow Corning Corporation.

4. They can be shaped at operation.

5. They will not absorb, necrose or change chemically.

6. They can be attached to -- or remain free of -- the living tissue as required.

7. They offer the surgeon an unlimited supply of reasonably good, readily available, material on hand.

8. They remove the need to obtain replacement tissue from other parts of the body, a procedure that creates a disfigurement while curing the original one. In addition, the tissue taken often absorbs in its new position.

9. They can be used to shield other materials, so that chemical and electrical devices, i.e. pacemakers, can be implanted for long periods.

10. They can be combined, so that composite dynamic devices such as artificial hearts are technically possible.

Extensive research studies have been conducted by Dow Corning Corporation and independent researchers to determine the effect of various silicone materials implanted inside the body. The results have been very encouraging. The silicones are unaffected by the body, and the body is virtually unaffected by the presence of solid silicone materials.

There is a growing list of applications for the silicones in medicine. Here are some representative examples:

HYDROCEPHALUS SHUNTS. Dating back to 1955, these valves are estimated to be implanted in over 300,000 patients. Often, they offer the only hope for the patient.

The earliest of these devices drained the cerebrospinal fluid away from the brain and into the blood system. Entirely subdermal, they exited from the ventricle of the brain through a burr hole in the skull, entered the jugular vein and continued into the right auricle of the heart.

The Ames Ventriculo-Peritoneal Shunt, developed in the early 1960's, directs the drainage of the CS fluid into the peritoneal cavity rather than into the blood system, thus avoiding the blood clotting mechanism, keeping surgical infection out of the blood stream and eliminating the need for revisions as the patient grows.

MAMMARY PROSTHESIS. Work on the prosthesis began in 1961; the first Silastic Mammary Prosthesis was implanted in 1962 and is still in place; the number of implants today is estimated to exceed 80,000. The earliest implants were for augmentation purposes. More recently, surgeons are using the prostheses as replacement of the excised mammary gland for reconstruction after subcutaneous mastectomy for benign disease and are showing increased interest in their use after radical or less-than-radical surgery for malignancies.

The Silastic Mammary Prosthesis is constructed from a silicone rubber envelope containing a silicone gel of the same general formula and closely approximating the weight and texture of breast tissue. The breast retains its natural appearance and even has, to quote one surgeon "excellent tactile fidelity."

ORTHOPEDIC IMPLANTS. Made of medical-grade silicone elastomers, they are flexible, durable and essentially nonreactive with bone, tissue and fluids.

FINGER JOINT IMPLANTS. These are used to help restore function and appearance to hands crippled by rheumatoid, degenerative or traumatic arthritis. Following the restoration, patients can find themselves again able to knit, use a typewriter or even play the piano.

OTHER ORTHOPEDIC IMPLANTS of medical-grade silicone elastomer for the wrist, arm and great toe also help restore function and appearance. Those Carpal Scaphoid and Trapezium Implants for use in the wrist; the Silastic Ulnar and Radial Head Implants for the inner and outer bones of the forearm, and the Silastic Great Toe Implant for use following an operation for bunions.

Medical-grade silicone rubber has proved particularly efficacious when used in devices to provide pathways in and out of the body. These devices are soft, nontraumatic, do not permit tissue ingrowth, are nonirritating and nonadherent to surrounding tissue so exiting body fluids do not adhere. It is this nonadherent property that minimizes encrustation. Such uses include urinary catheter, as well as intravenous tubes.

FOLEY CATHETER: Inner and outer surfaces of medical-grade silicone elastomer eliminate exposure of the patient's delicate mucous membrane to the possible irritating effects of conventional catheters. Encrustation is reduced significantly, fewer catheter changes are needed and the smooth nonwetting surface facilitates insertion.

CYSTOCATH SUPRAPUBIC DRAINAGE SYSTEM: A self-contained system for bladder drainage following gynecological surgery and for treatment of urinary

retention, the Cycstocath eliminates the potential complications of indwelling urethral catheters and repeated catheterizations.

TRACHEOSTOMY TUBE: This is a significant development in maintaining tracheal airway patency in prematures, infants and young children. It is essentially nonreactive, pliable, flexible and nonwetting.

MEDICAL-GRADE SILICONE RUBBER TUBING. Clear, seamless, flexible and essentially nonreactive to body tissue, this tubing will not support bacterial or common fungus growth.

REPAIR OF DETACHED RETINAS. By buckling the sclera against the retina with a silicone implant, a detached retina can be repaired and the patient's sight can be restored. Either silicone bands or silicone sponges can be used in the operation.

REPAIR OF DURA MATER. A silicone rubber-coated Dacron fabric is used to replace missing tough membrane surrounding the brain.

IMPLANTED PACEMAKERS. All pacemakers utilize silicone insulation on wiring; the material provides the needed flexibility.

SILICONE RUBBER RODS have been implanted in the hand for the development of new tendon sheaths through heavily scarred areas; after the new sheaths are formed, the rod is withdrawn and replaced with autogenous tendon.

THIN-WALLED SILICONE CUFFS have been used to eliminate painful neuroma formation on amputated nerves; they are also used to aid the repair of severed nerves.

A SILICONE GEL PAD is being used by hospitals throughout the country to help bedridden patients avoid bed sores.

MEDICAL-GRADE SILICONE BLOCKS are used to rebuild deformed or damaged faces. As chin implants, and rhinoplasty prostheses, the block is carved to the desired shape to correct the deformity of the patient. Also available are preformed implants for these purposes, and for rebuilding ears.

This list of applications is far from comprehensive, of course, for the development of the medical-grade silicones has been recent and medical researchers are still learning how to use the special properties of the material. In a typical month, for instance, Dow Corning receives hundreds of requests for information and for sample parts and silicone products. In addition, medical men and their designers visit the company frequently to discuss their problems and to learn more about the technology involved. And, staff members of the Center regularly visit medical research centers and deliver papers at medical meetings by invitation.

It appears that virtually all areas of the human body will be able to benefit from the special properties of the medical-grade silicones. In addition to the application already discussed, other implants such as for testicles, hernia reinforcement and similar uses are already on the market. Research is being done on prostheses for bile ducts, tear ducts, mandibles, tracheas, tracheal carinas, ureters, and many other areas.

One possible future application is of special interest because its use would be so widespread. Researchers are experimenting with silicone rubber

capsules that will permit the absorption of very minute amounts of drugs to the body over long periods of time, thus pointing to one possible solution to the problem of multiple, long-time medication. Animal experiments indicate that a capsule containing progesterone may prevent conception for many months when implanted in the body; the normal fertility pattern is restored in two or three days after the capsule is removed.

The tremendous advancements in surgical and materials technology have resolved many problems, but vital areas of research and experimentation still remain:

Work on artificial hearts and on heart assists is being done with silicone rubber. The present silicone rubbers, however, are neither strong enough nor sifficiently antithrombogenic for the application. Research is being done to improve these properties.

Still another need is for an implant that will contract with reasonable speed, amplitude and strength when an electric current is applied -- and will relax again when the current is withdrawn. The material would be of immense value in the development of the artificial heart and in a multitude of other muscular replacements.

The past, as always, is prologue to the future. Hopefully, the almost miraculous accomplishments facilitated by the use of these medical-grade silicones in just a few years are the harbingers of still more marvelous advances in medicine.

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BACKGROUND INFORMATION ON DOW CORNING CORPORATION

The birth of the silicone was closely followed by the birth of a new company. Dr. J. Franklin Hyde was hired by the Corning Glass Works in 1930 as its first organic chemist. He was given the assignment of exploring the possibilities of combining the advantages of glass and the newly-developed organic plastics.

Building on the work of Professor F. S. Kipping of the University of Nottingham in England, a leader in the silicon chemistry research field, Dr. Hyde developed the first practical, "silicone" (silicon and carbon) compound, a resin for use as an electrical insulating varnish.

The Corning Glass Works had developed woven glass fiber tapes for electrical insulation applications about this time. But they needed a material more heat resistant than varnish to coat them with. Because of their heat resistance, the silicones seemed to be the material needed.

Since the new silicone insulating varnishes were more organic than inorganic in nature, Corning needed help in manufacturing them. So they approached The Dow Chemical Company in Midland, Michigan for engineering and research help. The result was the formation of the Dow Corning Corporation, to be owned jointly by Corning Glass Works and Dow Chemical Company.

(MORE)

The new company operated for a year on just a handshake while the legal documents were being prepared. The year was 1943, and American was at war. High priorities were given Dow Corning for the construction of a factory and the procurement of equipment. The young firm was the sole source for several silicone products needed by the military.

The new plant went on stream in 1944. The first materials to be produced were the silicone fluids, rather than the electrical insulating resins which had been the original aim. Those first fluids, limited in quantity, were restricted to such applications as damping fluids in sensitive Air Corps instruments.

As production of the fluids increased, they were formulated into a silicone grease, which was used as a moisture-proof sealing compound in the spark plug wells of military aircraft. The silicone grease retained its consistency whether it had to withstand the high operating temperatures of the engine or the sub-zero airstream of high-flying planes. It was nonfreezing, nonmelting, inert, waterproof and an excellent electrical insulator.

Military specifications also demanded the addition of silicone fluids as anti-foam agents in many types of petroleum, for the speed of those World War II planes actually whipped regular lubricating oils into a foam.

In 1945, the development of silicone rubber was announced. It performs satisfactorily at temperatues too high for organic rubber.

None of these -- or any of the other products which emerged from Dow Corning in those early years -- saw civilian use until the cessation of hostilities in the summer of 1945. At that point, the silicones were without a market. But it was already apparent that silicones, in one form or another, could be employed profitably in every industry and that their peacetime applications would far outstrip the original military uses.

The list of applications today is virtually endless, with new ideas being developed almost daily.

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AR42

DOW CORNING corporate news

MIDLAND, MICHIGAN

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DATE: September 3, 1975

FOR IMMEDIATE RELEASE

DOW CORNING SEEKS APPROVAL
FOR SILICONE FLUID INJECTIONS

Dow Corning Corporation has filed a New Drug Application (NDA) with the Federal Food and Drug Administration (FDA), requesting approval to market a special, sterile silicone fluid to qualified physicians for injection purposes.

The fluid would be restricted to use for clinical conditions such as deformed faces, depressed scars and to repair surgical contour defects, according to Melvin E. Nelson, Manager of Dow Corning's Medical Products Business.

The application is the result of a 10-year clinical investigation of the injection of the special silicone fluid in the human body. The research, sponsored by Dow Corning and performed by eight physicians, was done in compliance with Federal regulations.

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The application does not affect the present restrictions on the general use of silicone fluid for injection purposes. The fluid continues to be available only under special circumstances and only to the eight authorized investigators. These restrictions are also in compliance with federal regulations.

Eventual distribution to qualified physicians other than the authorized investigators will depend upon the FDA review of the application. The decision will be based on whether the submitted research data prove both the material and procedure to be safe and effective.

The application does not include research on the injection of silicone fluid into the breast. This procedure has never been approved or recommended by Dow Corning.

"The medically acceptable means for enlarging the breast," Nelson explained, "is to surgically implant a silicone gel device. The implanting procedure is a currently available means of therapy and is not affected by this application."

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SPARE PARTS FOR YOUR BODY

By Silas A. Braley

ABOUT THE DOW CORNING CENTER FOR AID TO MEDICAL RESEARCH

Silas A. Braley, director of the Center, displays artificial jaw made from silicone rubber.

The birth of the silicones was closely followed by the birth of a new company. Dow Corning Corporation was founded in Midland, Michigan in 1943 by Corning Glass Works and Dow Chemical Company. The young firm was the sole source for several silicone products needed by the military. During the decade following World War II, medical researchers discovered some significant uses for silicone materials. Since Dow Corning was not equipped to assist these scientists, the company's board of directors established the Dow Corning Center for Aid to Medical Research. The Center acts as a clearing house for all information on the medical uses of the silicones. It also supplies medical scientists with research quantities of various silicone materials. All of this is done without cost to the researcher. Since its establishment in 1959, the Center has corresponded with more than 35,000 physicians and researchers in all areas of medicine. Its library contains approximately 4,000 scientific papers on the use of the silicones in medical research.

WHAT ARE SILICONES?

The element silicon is one of the most common elements on earth. About 25 percent of the earth's crust down to a depth of 10 miles is silicon. Most people are aware of silicon in the form of ordinary sand and glass.

As tough chemical cousins of granite, silicon compounds resist change. They are highly stable, and are unaffected by high and low temperatures and attack by other chemicals. They are also characteristically hard.

Carbon, on the other hand, is an element which is easily changed. Carbon atoms can be joined together and combined with other atoms in an almost infinite variety of molecular structures to produce substances with varied chemical and physical properties. Thus, gasoline and an ordinary plastic are both carbon compounds. Many carbon compounds are soft and rubbery.

Suppose it were possible to combine the inert, glass-like properties of the silicon materials with the softness of some of the carbon compounds. The result would be a completely new material — something not found in nature — a soft, glass-like substance.

Although the idea of combining silicon and carbon is more than a hundred years old, it wasn't until the early part of this century that chemists actually succeeded in producing "silicone" (silicon and carbon) compounds. At first, these materials were nothing more than laboratory curiosities. But then, as chemists learned more about their many unusual properties, important applications for these unique, man-made compounds began to appear. Soon, silicone compounds were being developed with custom-designed molecules to meet specific needs.

Today, silicones are found in floor polishes, paints, automobiles, glass cleaners, bathtub caulking, TV sets, space vehicles, and a host of other consumer and industrial products. The photograph above shows that silicones — made from the silicon in the rock on the left — can be produced in the form of liquids, solid blocks, tubing, gels and greases. Silicone compounds can be molded into an endless variety of shapes.

MEDICAL APPLICATIONS OF SILICONES

At the end of World War II, medical scientists discovered that water would not cling to a glass surface after it had been coated with a silicone. This fact was used to insure the complete drainage of penicillin bottles. Later, it was found that blood did not clot as quickly in contact with "siliconized" glass. By treating the bottles used to store whole blood, its useful shelf-life could be prolonged.

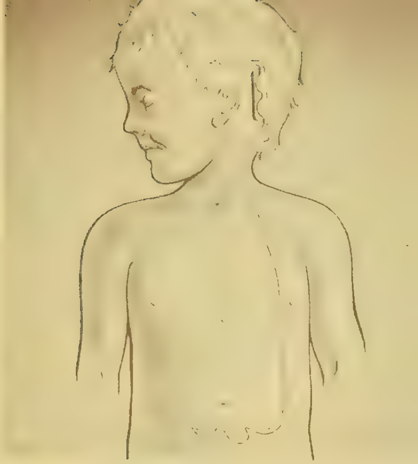
The development of a silicone rubber led to the adoption of silicone rubber tubing for blood transfusions and other medical applications. Physicians noted that hypodermic needles treated with a silicone caused less discomfort on the part of their patients. But these applications, while significant, are far overshadowed by the more recent development of silicone materials for tissue replacement.

The basis for the growing use of silicone rubber as a replacement for missing, diseased or damaged tissue lies, again, in the fact that it combines the inertness of silicon with the softness of many organic compounds. Early in this century, metals technology had developed some alloys which were inert enough to permit their implantation in the human body for long periods of time. Unfortunately, their use is limited to bone repair and replacement.

What was needed was a replacement for soft tissue. After all, our bodies are made up primarily of soft tissue. And this tissue is constantly moving, so any contact with a hard implant can result in serious tissue erosion. Soft materials, on the other hand, are equally unsuitable. The body quickly rejects foreign animal and vegetable matter. Also, these materials generally deteriorate very rapidly once placed inside the body.

Soft silicone materials appear to be ideal for replacing soft tissue. They can be made to closely simulate the textures of many different types of tissue — from the softness of fatty tissues to the hardness of bone.

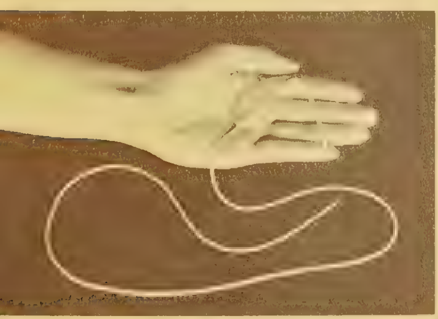
Extensive research studies have been conducted by Dow Corning Corporation and independent medical researchers to determine the effect of various silicone materials implanted inside the human body. The results have been very encouraging. The silicones are unaffected by the body, and the body is virtually unaffected by the presence of solid silicone materials.



THE HYDROCEPHALUS SHUNT:

The first practical application of silicone rubber in the medical world was the hydrocephalus shunt. Hydrocephalus is a condition in which an excessive amount of spinal fluid is accumulated in the brain. Another name for hydrocephalus is "water-on-the-brain." It is by no means rare, since thousands of infants are born with this problem every year.

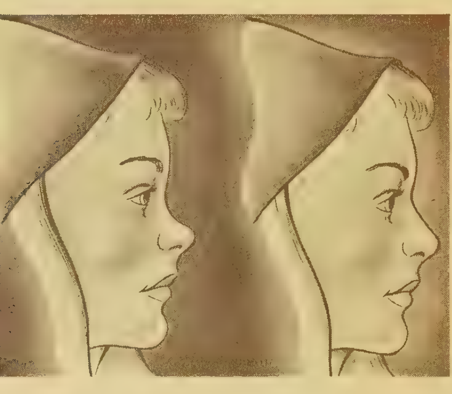
In its most severe form, hydrocephalus can cause serious brain damage and death. One method of relieving the pressure of the fluid inside the skull cavity is to make a small hole in the skull and to drain the excess fluid to some other portion of the body. The "shunt" used (shown in the above diagram) is made from silicone rubber tubing, to facilitate the flow of fluid away from the brain. It begins near the base of the brain inside the skull. Leaving the skull, it passes through a small pump chamber and continues down to the abdominal cavity where the fluid is harmlessly discharged. The greater portion of the thin silicone rubber tube is implanted just under the skin. Although carefully concealed, the pump can be activated by pressing the skin above it, thereby clearing any blockage in the tubing.



NEW LIFE FOR CHILDREN

More than 300,000 of these devices have been implanted since its development in 1955. Often, they offer the only hope for the child or adult afflicted by hydrocephalus. If the shunt is implanted early enough, the patient looks and acts like any other normal individual. In the case of a child, sufficient slack in the silicone rubber tubing enables the shunt to grow along with the patient. The little girl pictured on the front cover of this booklet has had a hydrocephalus shunt inside her body for several years.

REBUILDING DEFORMED OR DAMAGED FACES



The widespread use of the hydrocephalus shunt established the ability of a solid silicone material to remain inside the human body for an extended period of time without any serious reaction. The path of the silicone rubber tubing from brain to abdomen brought it in contact with many types of tissue and body fluids. Medical researchers reasoned that if silicone rubber could withstand constant contact with all of these substances, it might be successfully implanted in most parts of the body.

Surgeons, in particular, were interested in using silicone materials in rebuilding deformed or damaged faces. In some cases, such as the "saddle nose" shown on the left in the above illustration, patients suffer from a lack of tissue under the skin. Up until now, surgeons have had to obtain replacement tissue from other parts of the body. This procedure creates a disfigurement while curing the original one. And the living replacement tissue may not survive in the new location.

The availability of medical-grade silicone materials gives surgeons an alternative. The drawing on the right shows the woman's nose after a silicone rubber implant has been inserted under the skin. Silicone materials have been developed for rebuilding deformed or damaged faces including noses, ears, chins, cheeks and similar structures. Surgeons can obtain it in preformed shapes or in block form and simply carve it to fit the patient's need. Naturally, your physician is the best judge of whether a silicone implant is the best solution to your particular problem.

This silicone rubber implant is used by surgeons in forming ears. Open areas of the implant enable tissue to grow through the material, thus anchoring it firmly in place.

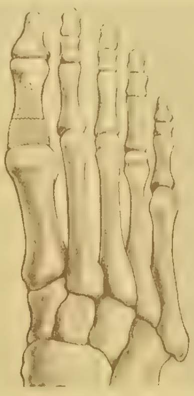
RESTORING FUNCTION AND APPEARANCE

Although silicone implants developed for cosmetic use are important in correcting a person's appearance and making it easier for him to live and work in society, they do not improve the workings of his body. Special silicone implants are now available which restore function as well as appearance.

A good example of this is the silicone finger joint. Two of these devices are shown in the photograph on the left below. They are used to repair hands crippled by rheumatoid, degenerative or traumatic arthritis, a condition in which the bone joints become large and practically useless. In correcting this condition, the excess tissue is removed from the hand and silicone finger joints are fitted into the bones. The above photographs show a typical patient's hand before (left) and after (right) the operation. Following the restoration, many patients find themselves again able to knit, use a typewriter or even play the piano.

Similar silicone implants have been developed for use in the wrist, arm and great toe. They are all flexible, durable and essentially unaffected by contact with bone, tissue and body fluids. Again, they serve to illustrate the inherent versatility of the silicones, since they can be made with exactly the physical properties required. The diagram below, for instance, shows a silicone toe implant in position. It enables a patient to walk naturally again, following surgery for bunions.

The silicone implants described in this booklet are produced by the Medical Products Division of the Dow Corning Corporation, Midland, Michigan. They are supplied to physicians and surgeons for use where appropriate in treating their patients.



These clinical photographs show a typical patient's breasts before and after insertion of silicone implants.

One of the most dramatic uses of silicones for tissue replacement is represented by the development of the silicone breast implant. It consists of a transparent, thin silicone rubber envelope containing a clear silicone gel of the same general weight and texture as breast tissue.

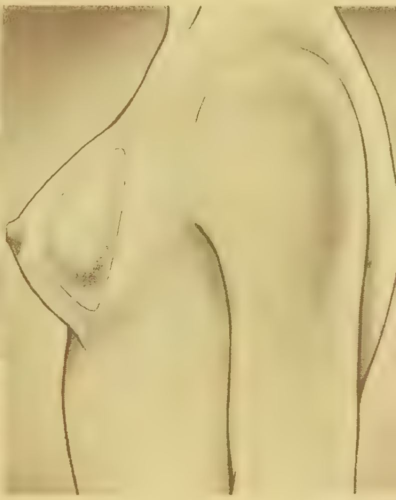
The operation in which the implant is placed under the breast tissue is relatively simple. A small incision is made just above the natural skin fold underneath the breast. The surgeon then creates a pocket under the breast itself to hold the silicone implant. After inserting and properly positioning the implant, he closes the incision. There are several techniques a surgeon can use for inserting the implant. In some cases, the operation is performed under local anesthetic, without hospitalization. Recovery is generally rapid, and the patient is often able to resume all of her regular activities within two to three weeks after surgery.

The patient who received the first silicone breast implant developed by Dow Corning in 1962 still has it. These implants may be expected to last a lifetime. The number of women with these silicone breast implants today is estimated to be in excess of 80,000. Every year, thousands of women choose to have the operation performed. Medical experts expect the number to continue to rise in the coming years. Incidentally, the typical woman receiving silicone breast implants is thirty years old and married, with children.

Silicone breast implants are made in several sizes and shapes. Although some women desire the largest implant, they may be physically unable to carry it. Or it may not be cosmetically attractive. The surgeon's training and experience enable him to select the right size and shape for his patient. He is aware of her special needs, and is dedicated to her welfare and personal satisfaction. His goal is to give his patient the best possible appearance.

BREAST AUGMENTATION AND RECONSTRUCTION

The earliest silicone breast implants were used merely to make the breasts larger. More recently, surgeons have been using the implants as replacements for tissue removed from the breasts in the course of operations for benign tumors. Some are showing increased interest in their use after radical or less-than-radical surgery for malignancies. Research now in progress may one day all but completely eliminate the need for any woman to lose the external appearance of her breasts.



The silicone breast implants shown above are made in a variety of sizes and shapes. The diagram on the right shows the location of an implant inside the breast.

Silicone breast implants are designed for safety as well as optimum appearance. If a severe bodily impact, say in an automobile accident, were to cause the silicone rubber envelope to break, the silicone gel inside would remain in position. Each implant is manufactured under strict quality control in pharmaceutical-type facilities with "clean room" precautions.The silicone materials used are extremely pure.

The use of silicone breast implants should not be confused with the injection of silicone fluids directly into the breast. Silicone injection has received a considerable amount of publicity in recent years. Many physicians and surgeons believe the injection of large quantities of liquid silicones into the breast is undesirable. This material may conceal breast cancer in its early stages.

The Food and Drug Administration does not permit the manufacture and sale of medical-grade silicone fluids for injection purposes. The only exception is in the case of eight medical researchers who have been licensed to inject normally small quantities of silicone fluids for cosmetic purposes. These scientists are pioneering in the development of new, safe techniques for improving a patient's appearance simply and inexpensively, without surgery. They are doing no breast injections.

Although the safety of silicone breast injections has not been established, some physicians and a number of unlicensed practitioners continue this practice — using nonmedical-grade silicone fluids. Thus, the patient is accepting a serious risk in subjecting herself to unproven silicone injection procedures.

THE FUTURE?

It appears that virtually all areas of the human body will eventually benefit from the development and application of medical-grade silicone materials. There are many other silicone devices now being used by physicians and surgeons or presently in some stage of research.

For example, silicone implants have been used to repair detached retinas and thus restore a patient's sight. Other silicone materials may be used to replace missing covering around the brain. The painful reaction from amputated nerves may be blocked through the use of thin silicone insulators. And silicone gel pads are even being used by hospitals throughout the country to help bedridden patients avoid bed sores and ulcers.

A wide variety of silicone materials are being used by medical researchers as aids in their scientific investigations. The device shown in the photograph at the top of this page is a special "mouse milker." It was developed by cancer researchers studying the cancer-causing mechanism associated with various types of breast cancer. The work called for sampling milk from the breasts of thousands of female laboratory mice. Silicone rubber proved to be the most effective material for transporting the precious liquid from mouse to test tube.

The list of silicone implants continues to grow. New applications are limited by the imagination. There are implants available as replacements for testicles, skull bone and jaws. Research is underway to develop replacements for bile ducts, tear ducts, tracheas and ureters, to name just a few. Other silicone materials are already being used to reinforce hernias and to aid in the replacement of tendons through heavily scarred tissue. Special penile implants have been used successfully to enable psychologically or physiologically impotent men to once again engage in normal sexual relations.

Up until now, the bulk of applications for the silicones in medicine has been limited to static implants. These devices will become much more sophisticated in the years to come, although the real future for implant materials lies in the development of functional devices — artificial implantable hearts, kidneys, lungs and muscles. The technology for these remarkable new developments is either here now or just on the horizon.

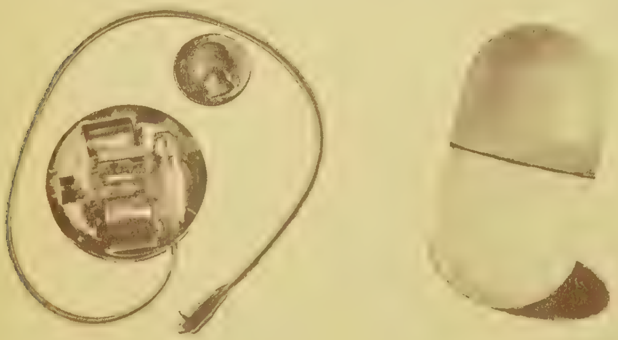
One such device is the revolutionary heart pacemaker. It produces tiny electrical impulses to trigger unstable heart muscles into beating regularly. Early pacemakers could not be implanted inside the body, but required the passage of electrical wires through the skin. Now many of these units are completely encapsulated with silicone rubber in order to isolate their components from the body. As a result, they may be placed inside the body for long periods without any risk to the patient.

The successful application of silicone rubber coatings to pacemakers has led medical scientists to look for other implantable devices containing non-silicone and normally unsuitable materials. One badly needed device is a unit that would be capable of contracting with reasonable speed and strength when an electric current is applied. It would then "relax" once the current is withdrawn. This expansion/contraction movement may be used to activate such things as valves in artificial hearts. It might be employed to replace a wide variety of muscular functions in other parts of the body as well.

Finally, scientists believe it is possible to chemically incorporate various types of drugs and medications into the structure of silicone compounds. Experimentation is now in progress on silicone rubber capsules that will permit the absorption of very minute amounts of drugs to the body over long times. This is one possible solution to the problem of administering multiple, long-term medication — perhaps pinpointing the area of application very accurately.

Animal experiments indicate that a capsule containing a contraceptive may successfully prevent conception for many months when implanted inside the body. Normal fertility can be restored in two or three days by removing the capsule. Hopefully, the almost miraculus accomplishments of researchers in utilizing the amazing properties of silicones are an indication that the best is yet to come.

Heart pacemaker (left) wire leads are encapsulated in silicone rubber to isolate it from the body. Silicone rubber capsule (right) slowly releases medication to the patient's body after implantation.



THE ARTIFICIAL HEART

The artificial heart shown above is made largely from various types of silicone materials in order to permit its long-term implantation inside the body. Substantial advances in recent years in the development of materials which are strong, yet capable of withstanding the effects of implantation, are enabling researchers to move closer and closer to the day when the artificial heart will be as commonplace as silicone breast implants.

At the present time, however, no material is completely satisfactory for this purpose. Since the human heart beats approximately 40 million times every year, the ideal material must possess exceptional endurance. Once an artificial heart is implanted, the patient's life depends on its reliability. Even a minor failure could result in immediate death. No known synthetic material is satisfactory for permanent contact with blood. Blood is eventually damaged by their presence.

Another major problem is powering an artificial heart. The power demands are so great that no existing implantable energy source can meet them. Scientists are investigating the possibility of using a miniature nuclear reactor. Silicone materials will play an important part in solving these problems.

Silicone from

DOW CORNING

DOW CORNING

FACTS ABOUT

CORNING

Corning Glass Works building at
717 Fifth Avenue, New York City

THE GLASS INDUSTRY

While glass dates back 6,000 years, it is only within the last 50 years that scientists began to fathom the unique nature of glass and to transform it from a fragile, unpredictable material into products with a broad range of qualities.

Today, glass can be made as light as cork or as heavy as iron, as soft as cotton or almost as hard as a diamond. The annual output of the American glass industry amounts to eight million tons, which sells for some two billion dollars.

The glass industry in the United States is generally divided into four major areas:

Specialty glass — Corning Glass Works is the leader in the field of specialty glass, manufacturing thousands of products with special properties, such as chemical stability, electrical resistance, light transmission and resistance to thermal shock.

Container glass — More than 25 billion glass containers are produced annually on automatic machines. The two largest companies in this field are Owens-Illinois Glass Company and Anchor Hocking Glass Corporation.

Flat glass—Plate and window glass producers serve the residential, industrial and institutional building industries. In recent years, over 50% of the industry's total output has been for automobiles. The two leading producers of flat glass are Pittsburgh Plate Glass Company and Libbey-Owens-Ford Glass Company.

Fiber glass—Commercial manufacture of glass fibers began in the 1930's and today they are used widely as structural, textile and plastic re-enforcement materials. The leader in sales and research in the glass fiber field is Owens-Corning Fiberglas Corporation, formed jointly by Corning Glass Works and Owens-Illinois Glass Company in the late 1930's.

CORNING TODAY

Corning Glass Works, one of the oldest industrial firms in the United States, traces its origin to a glass business established in 1851 by Amory Houghton and others in Massachusetts. Since 1868, Corning, N. Y., has been its headquarters. Early products, all of which are still produced in quantity, included railroad signalware, thermometer tubing and pharmaceutical glassware. A significant product line was added in 1879 when Corning produced the first incandescent bulb blanks for Thomas A. Edison.

35,000 PRODUCTS

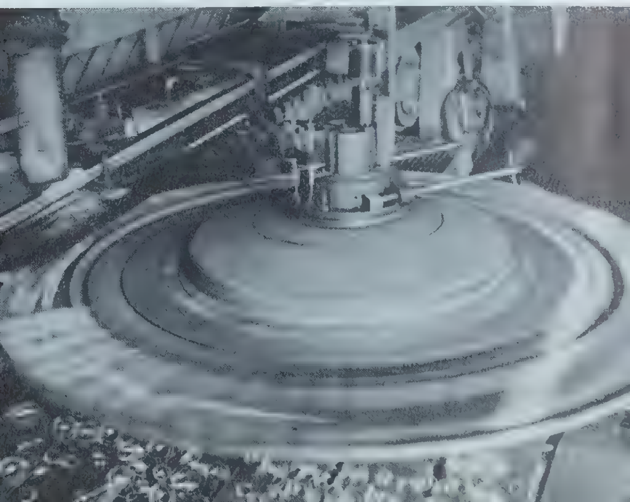
Today, Corning produces annually more than 35,000 different products.

A large portion of the business is in glass for electrical and electronic applications, such as incandescent lamps, fluorescent tubing, sealed beam headlamps, television bulbs, radio bulbs, and such other electronic components as printed circuits, diode and transistor cases, capacitors and resistors.

Another large market in terms of sales volume is in technical components: appliance parts, laboratory ware, engineered lighting ware, optical glass, glass piping and heat exchangers for the processing industries, and signalware.

A long established and currently rapidly

Development of the Corning "ribbon" machine made possible high-speed production of incandescent lamp blanks, radio tubes, flash bulbs.



growing field is in consumer products. These items include the well-known Pyrex brand cooking ware, the new Corning Ware cooking utensils made of Pyroceram glass-ceramics, Centura tableware and Christmas tree ornaments.

The company's New Products Division develops specific products and markets for new glass and ceramic materials as they emerge from the laboratory. The Steuben Division manufactures and sells Steuben crystal, world famous for its excellence of design, material and handcraftsmanship.

METHODS AND MATERIALS

The majority of our production is performed on high-speed automatic machinery. We use all of the standard methods of glass manufacture — pressing, blowing, drawing, casting—although many of these processes have been modified by company engineers to fit our special requirements.

Corning is a research-minded company, constantly seeking new and better materials and products for industry, science and the home. This policy has inevitably led to conservative, continued growth. Corning increased its sales from $115 million in 1951 to $229 million in 1961—a gain substantially greater than that of the national average during the same period.

Sealed beam lenses mass-produced at Greenville, Ohio, plant, are shown coming off lehr.

THE ROLE OF RESEARCH

The most important factor contributing to Corning's growth has been the success of its dynamic research and development program. The concept of glass and ceramics as versatile engineering materials, with virtually limitless possibilities, has resulted in the company's successful entry into many new product fields.

Corning's research laboratories were founded in 1908 because of management's early appreciation of science. This faith has paid off in a flood of developments — heat and corrosion-resistant borosilicate glasses; new high temperature refractories; tempering processes which greatly increase the strength of glass products; 96 per cent silica glasses for use at very high temperatures; a new method of producing fused silica; Pyroceram glass-ceramics, and Chemcor processes for strengthening glass chemically.

100,000 FORMULAS

Corning has more than 100,000 formulas for different glasses and ceramics on file — and each day approximately 30 new compositions are melted experimentally.

The success of the program can be attributed to Corning's firm belief in the value of long-term research and support of this faith in terms of ample funds. During the depression of the 1930's, for instance, the company expanded the research program at a time when most other companies were retrenching.

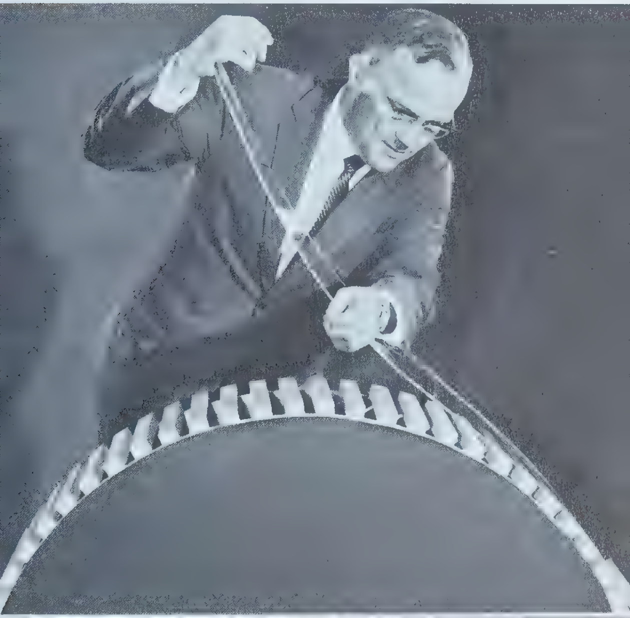
INVESTING FOR TOMORROW

Corning consistently spends more on research and development, as a percentage of its sales, than the average for all manufacturing industry in the United States. In the past 10 years, Corning's fundamental research has been expanded more than sevenfold and now constitutes more than one-fifth of the entire research and development program.

Few can estimate the place of glass in tomorrow's world. But there is no question that Corning will continue to lead in the search for new and better glass products.

By using its Chemcor processes for chemically strengthening glass, Corning can make glass so strong it can be bent or twisted.

The viewports (or windows) of America's space capsules are made of highly heat-resistant and shock-resistant glass at Corning.



MAJOR RESEARCH ACHIEVEMENTS

Heat-Resistant Glass—Corning developed in 1912 the first glass ever made capable of withstanding sudden jolts of heat or cold. These borosilicate glasses (so-called because of the large amount of borax used in the formula) were first used to make railway signal lanterns, later became well known to millions of housewives as Pyrex brand cooking and baking ware.

Ribbon Machine—Introduced in 1926, the Corning ribbon machine is one of the most fabulous glassmaking machines ever invented. It turns out incandescent lamp bulb blanks, radio tube blanks, and photoflash bulbs at speeds up to 2,000 per minute.

Electrical Sealing of Glass—Prior to this development in 1938, most glass was sealed to other glass by heating the ends in a gas flame and then joining them — a method still used widely for a number of products. Corning developed a new technique using electricity: by striking an arc through both pieces of glass, current flows through the glass, thus raising its temperature and causing it to fuse. This made possible a smoother, stronger seal.

96% Silica Glass—Corning in 1939 developed a method for removing practically all the constituents from a borosilicate glass—except the silica. This resulted in a glass that is nearly pure silica. The discovery was significant because it produced a glass of super heat-resistance so much so that a piece can be heated to 900°C. and then plunged into ice water without damage. Corning markets these glasses under the Vycor brand trademark.

Optical Glassmaking—Corning in 1942 developed a completely new process for making optical glass—the continuous melt method—making possible for the first time mass production of ultra high quality optical glass.

Ribbon Glass—In 1943, Corning developed a method for drawing glass an inch wide and extremely thin—about as thin as newsprint. This process, together with special glass compositions, made the new "ribbon glass" ideal for use in electronic components.

Centrifugal Casting—Corning developed in the late 1940's a revolutionary new way to form glass—by centrifugal casting. In this method, a gob of molten glass is dropped into a mold, the mold spins, and the glass is thrown up the sides of the mold. Corning used this process first to make the funnels of television bulbs.

Photosensitive Glasses — Developed in 1947, this family of glasses behaves much like photographic paper when exposed to ultraviolet light and developed by heat treatment. Thus, an image can be permanently formed through the entire thickness of the glass. The exposed areas will dissolve rapidly in acid, making it possible to produce highly intricate patterns in a piece of glass.

Because any desired pattern can be etched into them, the photosensitive glasses are used for such things as printed circuit boards for electronic circuits.

Electrically Conducting Coated Glass—By developing in 1950 a technique to coat glass with a metallic oxide film that conducts electricity, Corning reversed the classic role of glass as an insulator.

Fused Silica—Although fused silica has been made for years, Corning developed in 1952 a new manufacturing process which produces the purest fused silica ever made.

Glass-Ceramics—Developed in 1957 and marketed under the trademark of Pyroceram, this family of materials results from a conversion process during manufacturing: the raw material is melted as a glass, then converted by special processing to a ceramic. The result is a super-strength glass-ceramic which has greater strength and hardness than the parent glass.

Chemically Strengthened Glass—In September, 1962, Corning announced the development of methods (called the Chemcor processes) for strengthening glass chemically. By using these processes, Corning developed on a laboratory scale glasses up to five times stronger than ever before possible.

WHERE WE'RE LOCATED

PLANTS

Corning, N. Y.

- Equipment Plant
- Fall Brook Plant
- Main Plant
- Radome Plant
- Pilot Plant 2
- Pressware Plant
- Steuben Factory
- Ceramic Plant

Albion, Mich.
Big Flats, N. Y.
Bradford, Pa.
Central Falls, R. I.
Charleroi, Pa.
Danville, Ky.
Danville, Va.
Greencastle, Pa.
Greenville, Ohio
Harrodsburg, Ky.
Martinsburg, W. Va.
Muskogee, Okla.
Paden City, W. Va.
Parkersburg, W. Va.
Raleigh, N. C.
Sydney, Australia
Wellsboro, Pa.

SALES OFFICES

Atlanta (22), Ga.
1401 Peachtree, N. E./TRinity 6-5936

Chicago (54), Ill.
Merchandise Mart/DElaware 7-6600

Cleveland, Ohio
1310 Terminal Tower Bldg./TOwer 1-6786

Corning, N. Y.
962-5011

Dallas (1), Texas
905 Southland Center/RIverside 8-2436

Houston (27), Texas
3202 Weslayan St./MOhawk 6-0384

Anaheim, Calif. (Los Angeles)
420 S. Euclid Ave./PRospect 2-5400

New York (22), N. Y.
717 Fifth Ave./PLaza 2-1100

Pittsburgh (22), Pa.
Four Gateway Center/GRant 1-3538

Raleigh, N. C.
Electronics Drive/833-1685

San Francisco (3), Calif.
Merchandise Mart/MArket 1-9621

Washington (5), D. C.
711 14th St., N. W./EXecutive 3-5577

A WORD ABOUT . . .

OUR PEOPLE

Corning's employe relations policies are among the best in all industry. An industrial pioneer in such things as group insurance (1917), pensions (1922), and a company-sponsored medical and dental program (1922), Corning has long regarded the treatment of people as one of its most important responsibilities. Of our 15,000 employes, more than half have been with us for ten years or more, and many of our people represent third and fourth generations of the same family to work for the company.

In dealing with its employes, Corning believes:

- In the dignity of the individual, and the importance of mutual human understanding and respect.
- That employes want to do a good job, and thus will measure up to their basic sense of responsibility.
- In the employe's need for personal recognition, and in his desire to feel he is part of the company's success.
- In keeping an open mind when listening to employes' problems and suggestions, and in encouraging employes to advance to the limit of their capacities.

OUR COMMUNITIES

Corning Glass Works is genuinely interested in the welfare and attitude of its plant communities.

It is our policy:

- To be a good industrial citizen and neighbor.
- To pay our own way in the community, expecting no concessions, financial or otherwise, from the community.
- To support and promote community welfare programs.
- To encourage our employes to participate in worthwhile community projects.

OUR AFFILIATES

A company built on the policy of continuous research is apt to develop unusual products, some of which may not fit logically into that company's activities. This has occurred a number of times in Corning's history.

Under such circumstances, the company's practice is to form relationships with other strong organizations instead of duplicating their facilities.

The first three associated companies listed below are a direct result of this principle.

Pittsburgh Corning Corporation
(Pittsburgh, Pa.) — Established in 1937 by Pittsburgh Plate Glass Company and Corning Glass Works. Principal products: Glass blocks; insulating materials, including Foamglas, the only cellular glass insulation, and Foamsil, a 99 per cent fused silica insulating and refractory material.

Owens-Corning Fiberglas Corporation
(Toledo, Ohio)—Established in 1938 by Owens-Illinois Glass Company and Corning Glass Works. Principal products: fibrous glass in various forms, such as wool, mat, yarns, filaments, flakes and fiber for reinforcing plastics.

Dow Corning Corporation
(Midland, Mich.)—Established in 1943 by the Dow Chemical Company and Corning Glass Works. Principal products: Silicone fluids, greases, resins, and rubbery materials.

Industrial Reactor Laboratories, Inc.
(Plainsboro, N. J.) — Established in 1956 by Corning Glass Works and nine other leading American corporations. Corning is using the IRL facilities to accelerate the development of stronger, more durable glasses.

The company's wholly-owned domestic subsidiaries are:

Corhart Refractories Company
Louisville, Ky.—Established in 1927, Corhart's operations are devoted to the development, manufacture and sale of refractories used in the glass and steel industries. Plants in Louisville and Buckhannon, W. Va.

Corning Fibre Box Corporation
Corning, N. Y.—Established in 1924, this corporation manufactures packaging material for Corning's products, and for other industries. Plants in Corning and Frederick, Md.

The company's foreign interests include:

Corning Glass Works of South America, S. A.,
Buenos Aires, Argentina, was established in 1942 to handle Corning's expanding interests in the southern hemisphere. This is a holding company owning shares in Cristalerias Rigolleau, S. A. (Buenos Aires).

Vidros Corning Brasil, S. A.,
Sao Paulo, Brazil, established in 1944, is a holding company owning shares in Cia. Vidraria Santa Marina, S. A., a Brazilian corporation.

Cristalerias de Chile, S. A.,
Santiago, Chile—Manufactures bottles and the company's products in Chile; established in 1904.

Corning Glass Works of Canada Ltd.
Leaside, Ontario—Manufactures and sells the company's products in Canada; established in 1945.

Corning Glass International, S. A.,
Panama City, R. P., with offices in Zurich, Switzerland, New York and Corning, N. Y., sells abroad the products of Corning Glass Works and Corhart Refractories Company; established in 1959.

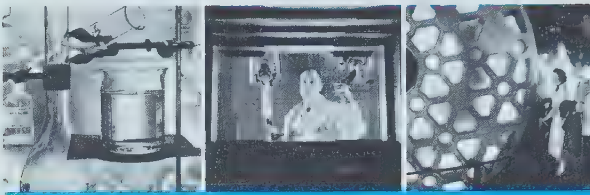
James A. Jobling & Co. Ltd.
Sunderland, England—Manufactures and sells the company's products in England; established in 1858 as Wear Glass Works.

SOVIREL
Paris, France — Manufactures and sells the company's products in France; established in 1922.

L'Electro Refractaire
Paris, France—Manufactures and sells Corhart refractory products in European markets; established in 1928.

REPRESENTATIVE PRODUCTS

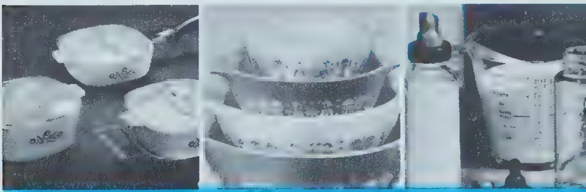
Glass for Science



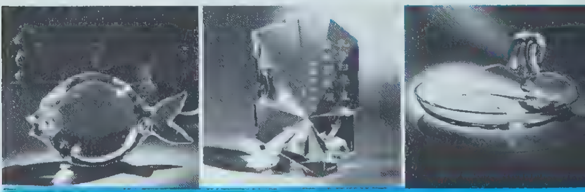
Glass for Industry

Glass for Electronics

Glass for the Home

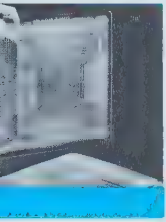


. . . and Steuben Crystal



Laboratory ware
Radiation windows
Telescope mirror blanks
Optical and ophthalmic glass
Micro sheet
Missile radomes

Color filters
Thermometer tubing
Pharmaceutical ware
Space capsule viewports
Tissue culture glassware
Aircraft windshields



Lighting lenses
Heat exchangers
Sight glasses
Glass piping
Sealing glasses
Gauge glasses
Refractories
Radiant heaters

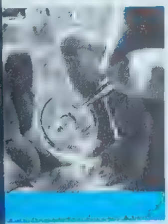
Milking machine parts
Blueprint cylinders
Fractionating columns
Signal ware
Infra-red reflecting glass

Television bulbs
Radar bulbs
Incandescent bulbs
Fluorescent tubing
Printed circuits
Sealed beam parts
Antenna insulators
X-ray bulbs

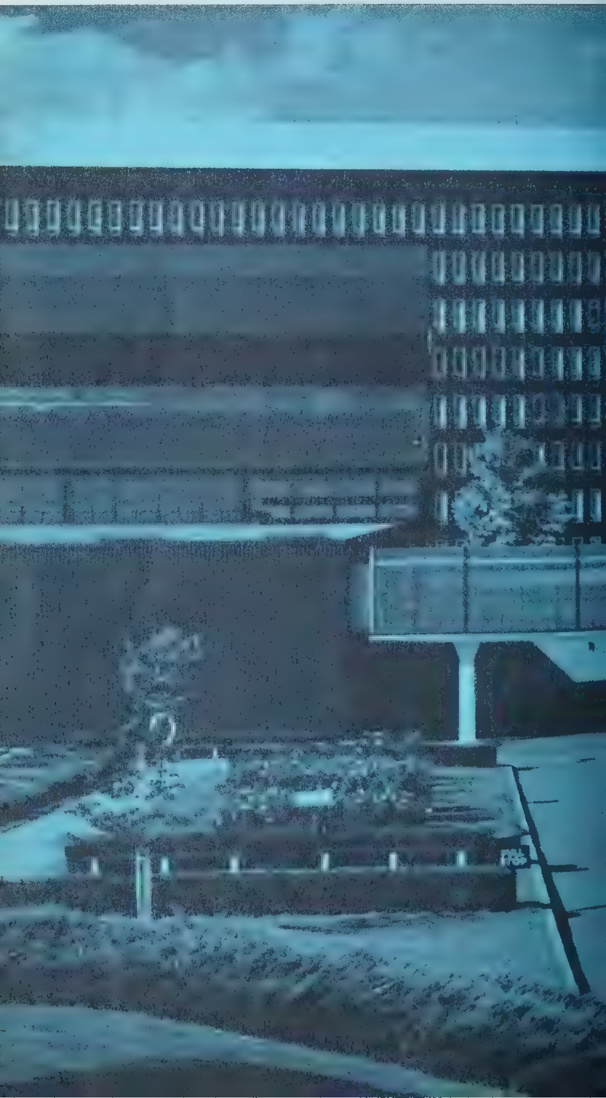
Inductances
Capacitors
Neon tubing
Photoflash and radio bulbs
Ultrasonic delay lines
Resistors

Centura tableware
Corning Ware cooking utensils
Nursing bottles
Range-top ware
Pyrex brand ovenware

Beverage servers
Tumblers
Christmas ornaments
Carafes
Pyrex brand kitchenware
Decor dinnerware



AR42



MATERIALS NEWS
from DOW CORNING / MARCH/APRIL 1971

automation process – page 3

Materials for the 70's: Dynamic Materials

By Henry R. Clauser

"The medium is the message," a phrase propounded by Marshall McLuhan, the popular Canadian savant, has been quoted widely over the past few years. But long before McLuhan burst on the scene, an electrical engineer turned linguist by the name of Benjamin Whorf said about the same thing, only in less dramatic terms.

He put forth the theory that the structure of our language determines the way in which we perceive and think about things. He said "... language is not merely a reproducing instrument for voicing ideas but rather is itself the shaper of ideas, the program and guide for the individual's mental activity, for his analysis of impressions, for his synthesis of his mental stock and trade."

What does all this have to do with the field of materials? Applied to science and engineering – and specifically to the study, development and application of materials – Whorf's theory says that our linguistic system largely determines how we visualize materials. Thus, our language structure has unwittingly led us to characterize phenomena and materials primarily as static objects. For example, pressure, electric power, and materials properties are nouns and not verbs, even though they refer to actions, processes, or "happenings."

Modern materials science and engineering tells us that materials are dynamic and functional, and that they can, and often do, change in service. Or in linguistic terms, we might say that materials are active verbs instead of passive nouns.

The implications of this notion that materials are active and functional rather than inert, are far-reaching. One of the most significant is that materials can be designed as end-products to perform the operations of components and mechanisms. With the development of the silicon transistor, the electronics field made the first major use of this concept. Since then composite blocks, wafers and thin films have been created to perform electronic functions that previously required an array of numerous bulky components.

This functional approach is also useful in applications in which the material is subject to other inputs, such as mechanical force and heat. A simple example of a functional material replacing mechanical parts is the use of the "hinge effect" of polypropylene to transmit the power and motion in an electric toothbrush instead of a nine part mechanism.

In the case of thermal inputs, thermostats and heat sink devices are

Continued on page 11

Henry R. Clauser, former editor and publisher of MATERIALS ENGINEERING magazine, is now serving government, industry, education and publishing as writer, consultant, teacher and lecturer.

MATERIALS NEWS®
from Dow Corning Silicones Inter-America Ltd.

In this issue

DOW CORNING SILICONES INTER-AMERICA LTD.
TIPPET ROAD, DOWNSVIEW
METROPOLITAN TORONTO, ONTARIO

DOW CORNING

On KODAK cameras . . .

Thin-film lubricant doubles tool life in stainless forming

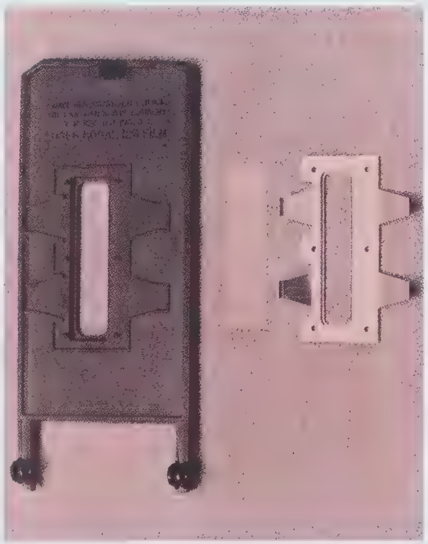
A clear wax-like lubricant has extended tool life by more than 100 percent in a stainless steel forming operation at the Kodak Apparatus Division of Eastman Kodak Company, Rochester, N. Y. After forming, the lubricant is not removed because it does not adversely affect the appearance of the part or attack the plastic materials to which it is assembled. Therefore, fabrication and assembly can be accomplished in one continuous, automatic operation on the same machine.

Use of *Molykote* 557 lubricant is one of many cost-saving techniques that has enabled Kodak to sell its Instamatic 44 camera for less than $10.00.

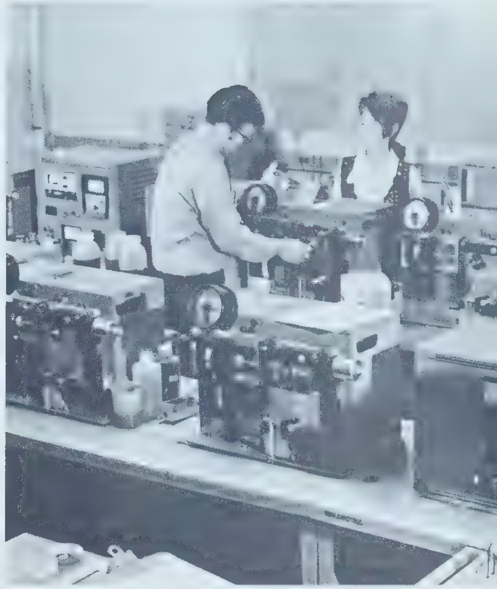
The stainless part is a spring pressure pad that is mounted in the back of the camera and serves to align the film cartridge and also hold an acetate window in place. It is formed from 0.005-in.-thick Type 301 stainless strip. Synthetic wax lubricants previously used had a tendency to build up on the dies quickly. This caused an excessively high rate of tool breakage, especially on small punches that cut 0.060-in. diameter holes in the spring. (MN-26)

Liquid Molykote 557 lubricant is applied to stainless strip by two felt wicks, which are reservoir-fed.

Back components of a Kodak Instamatic 44 camera consist of a polystyrene molding, an acetate window, and stainless steel spring pressure pad.



New lab offers friction and wear testing service



The services, facilities and staff of one of the country's most completely equipped friction and wear testing laboratories are now available to conduct test programs on a custom basis. The Dow Corning laboratory at Trumbull, Conn., is used to develop and evaluate all types of lubricants, friction and wear testing equipment and test methods. Its staff is experienced in the design and execution of test programs and analysis of results. Friction and wear characteristics of various combinations of materials (plastics as well as metals) oils, greases and solid films can be evaluated under controlled environmental conditions. (MN-27)

Model of a sofa leg is compared with silicone rubber pattern.

Molten alloy is poured into a Shaw Process ceramic mold.

Tool steel molds gain high detail from RTV patterns

Cleveland Precision Casting Co., a Shaw Process foundry, uses *Silastic* RTV silicone rubber to make the rubber pattern that is the critical first step in this precision casting process for creating high-definition production molds made of tool steel or other metals.

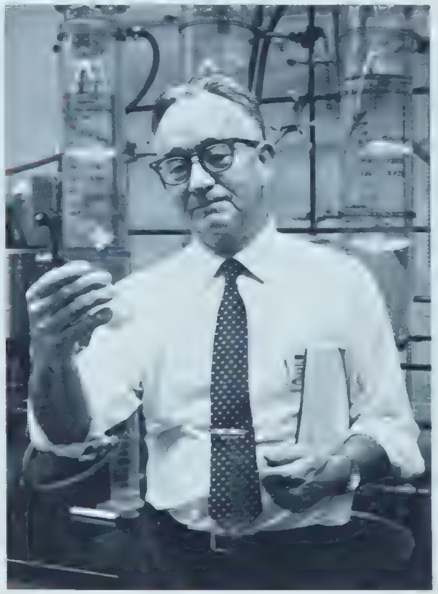
The silicone rubber transfers the fine details of the model to a rubber pattern that is a precise reproduction in negative form. Besides its ability to reproduce intricate detail, the silicone rubber has the high strength and tear resistance—even in thin sections—to withstand stripping from the model and pouring the ceramic Shaw mold.

Ted Macejek, vice president of the Cleveland foundry, says the Shaw casting process lends itself to intricate designs, mass production and elimination of secondary operations. Lead times are a month or less, and cost is a fraction of conventional methods for making production molds. (MN-28)

Perkin Medal awarded to Dr. J. F. Hyde

Dr. James Franklin Hyde, senior scientist and consultant in Dow Corning Corporation's research and development laboratory, has been named Perkin Medalist for 1971. Established in 1906, the Perkin award is one of the highest honors given for outstanding work in applied chemistry in the United States. Dr. Hyde has been continuously engaged in laboratory research in the field of organosilicon chemistry for the past 39 years, including 19 years with Dow Corning. He performed the first successful applied research on silicones, leading directly to the first commercial products. He holds 86 U. S. patents and continues to contribute to the growth of the silicones industry.

Dr. Hyde at work



Pennsylvania first with silicone-alkyd paint specification

The Commonwealth of Pennsylvania, Bureau of Materials, has adopted a silicone-alkyd paint specification for metal structures, making it the first state to officially recognize the economic advantages of this type of coating. The bureau has revised its Bulletin No. 26, which deals with paint specifications for bridges and other metal structures, to include an azure blue, 30 percent silicone-alkyd enamel system that meets MIL Spec 490. The first application has already been completed by Engineering District 6 on three main spans of the Penrose Avenue Bridge, a 7,900 ft. long structure across the Schuylkill River at Philadelphia. Repainting of the center spans cost $179,000. If an organic paint was used, the cost would have been $159,000. But with a maximum coating life of 10 years for organic paint, the cost per year would be $15,900. The silicone coating normally lasts 50 percent longer, so that in 15 years the cost per year is projected at $11,900. (MN-29)

1984—that's when this section of the Penrose Avenue Bridge is scheduled for repainting.

IC silicone packages gain military interest

From an article by E. R. Hnatek, National Semiconductor Corp., published in EDN, Nov. 15, 1970

Why should the military be interested in plastic encapsulated integrated circuits? One good reason is cost — plastic packages are much less expensive than hermetic types. More important, results of recent reliability tests show that silicone molding compounds hold promise of fulfilling many military requirements.

Rome Air Development Center has been a leader in the IC reliability drama, with semiconductor firms playing important supporting roles. One of the firms, National Semiconductor Corp., conducted a series of reliability tests on ICs packaged in epoxy and silicone plastics. The silicone packaged devices proved to be considerably more reliable than any other plastic tested. (MN-30)

Tests Results for Plastic IC Packaging Materials

	PHENOLIC DTL, (%)	EPOXY DTL (%)	LOT A SILICONE DTL, (%)	LOT B SILICONE DTL, (%)
Life Test: relative humidity, reverse bias at 1500 hrs. and 150° C	7.8	4.0	2.0	0
Pressure Pot: percent of weight gain	1.02	0.88	0.08	0.13
Pressure Pot: 24 hrs.	4.2	96.0	4.0	0
Thermal Shock: 240	4.6	62.5	4.0	0
Moisture Resistance: 168 hrs 85° C, 85% relative humidity	1.0	0	0	0

Sample size: 2500 units.

NOTE: Early package design problems, which have since been corrected, caused the difference in failure rates between the silicone DTL devices of LOT A and LOT B. The reliability figures of redesigned silicone DTL package now compare with those listed for LOT B.

Source: Rome Air Development Center

New type swimming masks made of silicone rubber are assembled at Hoffman Engineering, Inc. The goggles fit snugly to facial contours.

New swim goggles resist ozone, chlorine problems

A new face-fitting silicone rubber training mask designed by Aubrey Burer, former Olympic and all-American swimmer, is said to be the first to fully protect the eyes of competitive swimmers in daily water use. Burer worked closely with the manufacturer, A. C. Hoffman Engineering, Inc., Riverside, Calif., in developing the durable masks.

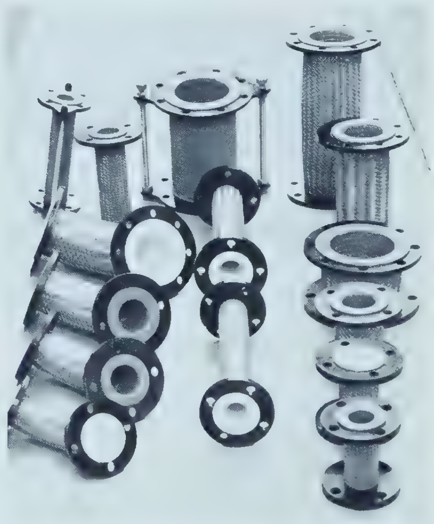
The "Eye-Saver Goggles" adjust snugly to facial contours and do not loosen even during fast turns or in a poolside diving entry position. Silicone rubber was selected for the masks to eliminate the main drawback of natural and synthetic rubbers: cracking and disintegration caused by ozone and ultraviolet rays, and swelling due to chemicals in the water.

The masks are molded of high strength, flexible *Silastic* 55 silicone rubber. Adjustable straps are made of *Silastic* 75 silicone rubber, which has slightly more stiffness. Because of the excellent physical and chemical properties of these two materials, the manufacturer guarantees the masks for one year. (MN-31)

Steel, rubber hose is flexible, durable

An unusual type of convoluted metal hose designed by Thermo Tech, Inc., Denver, Colorado, uses a combination of silicone rubber and stainless steel to deaden sound and vibration in pipelines, allow for thermal expansion and contraction, and to prevent corrosion.

The flexible connectors and elbows, marketed after five years of development and field testing, utilize the strength of stainless steel bellows and braid, and the flexibility, inertness and temperature resistance of *Silastic* silicone rubber. The design has been proved in a full year of service in the food, chemical and hydronics industries. It is serviceable at temperatures from −40 to 400 F and pressures to 300 psig. (MN-32)



These flexible connectors and elbows will take pressures up to 300 psig and temperatures from −40 to above 400 F.

SILICONES

Expanding Their Image

Silicones—28 years young and traditionally boxed in as the "Rolls Royces" among elastomers—are changing their image. They want 'in' as a general-purpose family of materials. Increasing emphasis on 'true' performance and maintenance costs, rather than simply material costs, is the reason.

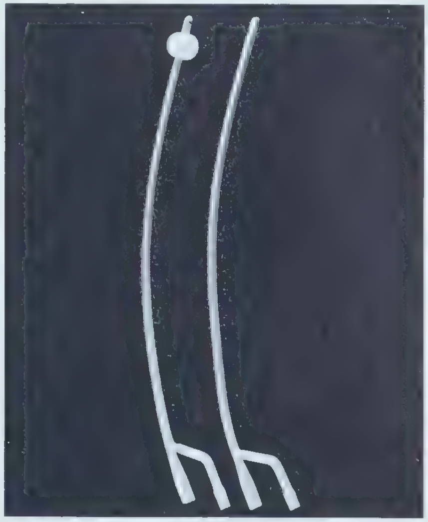
The trend of silicone prices is downward. During the last five years, general-purpose silicone rubber has dropped on the average from $3.00 to $1.74 per lb. In large volume applications, two-part RTV's are down about 30 percent from an average of $5.00 to $3.50 per lb. One-part RTV's in bulk containers

place gasket made of one part RTV silicone rubber sealant provides complete oil tight seal. Technique offers cost saving op because finish machining operations can be reduced or eliminated. (Dow Corning Corp.)

The above clipping from the January 18, 1971 issue of *Design News* is the first page of an in-depth article dealing with the emergence of silicones as general purpose OEM and maintenance materials. The author notes that this change is the result of two main factors: (1) a sharp reduction in price differential between silicones and older materials, and (2) long-term performance and design advantages offered by the silicones. Lower prices have resulted from both improved production techniques and increased production volume. The comprehensive article contains product and economic information for designers, manufacturing engineers, and maintenance engineers. Reprints are available from Dow Corning. (MN-33)

Silicone coated catheters save nurses' time

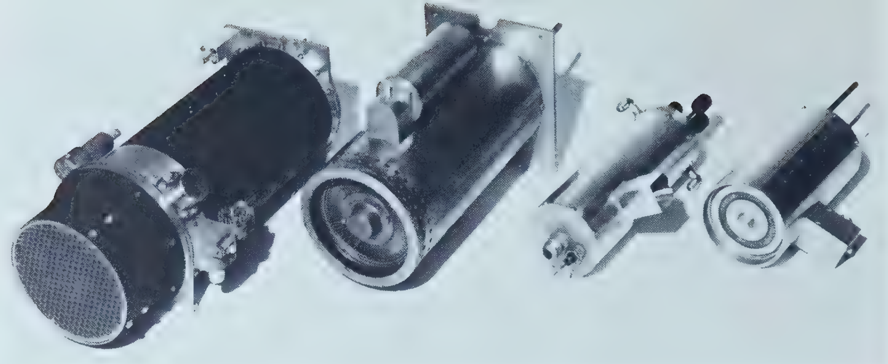
A study by the Visiting Nurse Assn. of Pulaski County, Ark., revealed that *Silastic* silicone rubber-coated Foley Catheters saved nursing time and replacement costs because fewer changes were required. The study, conducted on 14 elderly female patients, indicated that the silicone surface helped reduce observable tissue reactivity and urethral irritation. Longer indwelling periods were possible because the nonwetting silicone elastomer surface minimized calcification buildup on the catheter eyes, balloon and lumen. As an extra benefit the chance of bacterial infection from repeated catheter changes was reduced. (MN-34)



The Foley Catheter is made of latex with a layer of medical-grade silicone elastomer bonded to the drainage lumen and outer surface.

Fluid dielectric reduces size of airborne hf units

From an article in ELECTRONIC DESIGN, December 20, 1970, by Lauren K. Findley, Principal Project Engineer, Electronic Communications, Inc.



These are all 1-kw uhf cavities covering 225 to 400 MHz. The unit, second from right, is cooled with fluid dielectric; the others are air cooled. Only the fluid-dielectric unit is capable of producing full power over the full frequency range at 100,000 ft altitude.

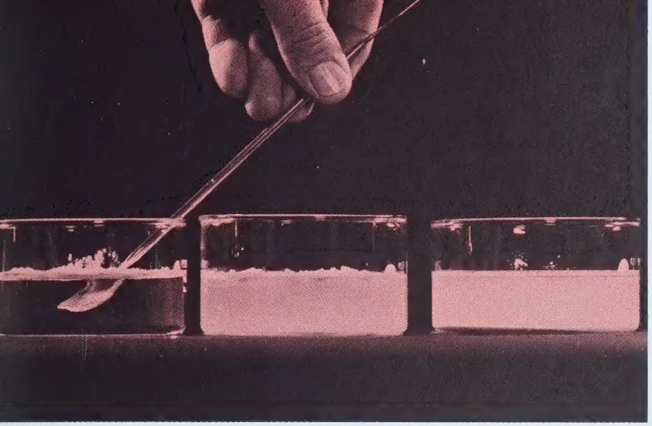
Dramatic size reductions in high-power airborne electronic equipment are possible when a fluid dielectric is used for cooling instead of air. This has been substantiated by tests in which *Dow Corning* 200 fluid, a nonflammable silicone oil, was used as the dielectric fluid in a 1-kw uhf cavity amplifier. It was found that the fluid can be circulated to carry away heat dissipated by the equipment. At the same time, the fluid's superior dielectric strength allows it to act as a more effective insulator than air.

This permits significant size reductions in the equipment by allowing closer spacing of high voltage structures. Also, the fluid has a higher dielectric constant than air, permitting reductions in the size of distributed circuits in rf equipment. (MN-35)

Travel trailers made leak-proof by silicone sealant

Front window on travel trailer (left) is made watertight with silicone rubber sealant. Sink cabinet inside trailer (right) is sealed with same material.

A Michigan travel trailer dealer uses a silicone rubber material to effectively eliminate water leaks caused by highway vibration. Charles Turnwald, owner of Frank Trailer Sales in Battle Creek, uses *Silastic* 732 RTV adhesive/sealant to repair windows, door frames, counter tops and other areas subject to water leaks, both inside and outside the trailers. The silicone material is used in the service department and in refurbishing used trailers taken in trade. The dealer also sells the sealant to trailer owners who prefer to make their own minor repairs. Available in 5-ounce tubes in white, black, clear and aluminum, Turnwald says it can be used virtually anywhere on the trailers. (MN-36)



Dry or wet. The versatility of silicone powder treatments is shown by this demonstration in which equal quantities of a powder were dropped into equal quantities of water. The powder on the left was treated with a water repellent silicone fluid; the powder in the center was untreated; and the vessel on the right contains powder treated with a silicone wetting agent. Elapsed time: 15 minutes.

Silicone treatments can change powder surfaces

Three different silicone treatments help powder producers or processors change the surface character of powders, particles or granules.

Small amounts of the silicone, in the range of 0.01 to 1.0 percent produce different effects. Application is simple and can normally be combined in the process with little or no extra work.

Dry powder treatment results in a cured film surface. The powder is highly water repellent and remains free-flowing and anti-lumping for many years. *Dow Corning* 1107 fluid plus a room temperature active catalyst is the silicone most widely used.

Wettable powders must give rapid wetting when mixed with water. If a powder tends to lump, clump and gum up or is difficult to mix in water, *Dow Corning* 470A fluid, mixed in concentrations from 0.01 to 0.5 percent, greatly improves wettability.

Lubricated powders refers to particles themselves. Powders or particles that slide freely over other particles permit great improvement in pigment grinding or particle reduction. *Dow Corning* 200 fluid or emulsions of the fluid in water systems makes the powder free flowing and more mixable with plastics, mastics. (MN-37)

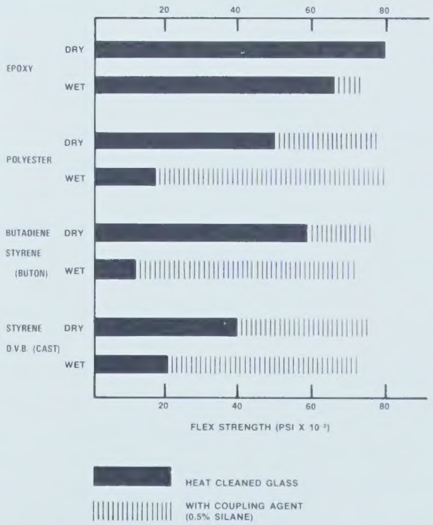
On metal surfaces . . .

Reactive silanes promote adhesion of coatings

From a paper presented by E. P. Plueddemann, Dow Corning Corporation, at the Tenth Biennial Western Coatings Societies' Symposium and published in the Nov. 1970 issue of JOURNAL OF PAINT TECHNOLOGY.

The marked improvement in properties imparted to many glass fiber-reinforced plastics by use of traces of appropriate reactive silane coupling agents suggests that these reactive silanes may also be valuable in improving the adhesion of organic coatings to hydrophilic mineral surfaces. Successful application of silanes as adhesion promoters in coatings requires an understanding of the mechanism of adhesion to mineral surfaces through silanols so that full benefit can be derived from these coupling agents.

A new working theory of adhesion is now proposed that is consistent with all commonly observed phenomena of reinforced plastics. Through use of reactive silanes, it should be possible to formulate systems providing strong water-resistant adhesion of any organic coating to hydrophilic mineral surfaces. (MN-38)



Equalizing effect of silane coupling agents on glass cloth laminates made with four different resins. All results based on compression molded test samples containing 60-70% glass in the laminate.

Kiln cars roll longer on silicone-greased wheel bearings

At the Kendrick Brick Company, Monroe, N. C., the wheel bearings of 10 kiln cars have operated smoothly for nine months since being packed with *Dow Corning* 41 grease, a medium consistency lubricant made from silicone oil thickened with carbon black. Wheel bearings of identical kiln cars lubricated with a petroleum-based, high temperature grease must be relubricated every six weeks.

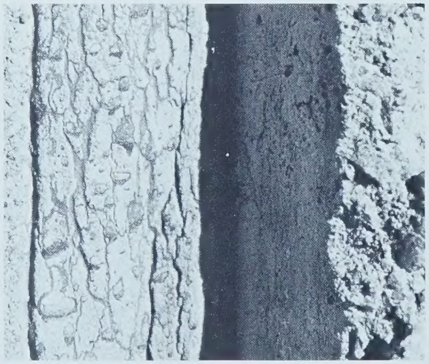
Each rail-mounted car makes about three 60-hour trips through a kiln every two weeks, loaded with 16,400 lb of bricks. During each trip a car spends 12 hours in the furnace section where ambient temperature beneath the floor is 350 F. At such temperatures, conventional greases bleed out and decompose, leaving a residue that interferes with bearing operation. (MN-39)

Kiln car wheel bearing is lubricated with silicone grease at Kendrick Brick Co. These cars operate at least six times longer than those lubricated with petroleum-based grease.

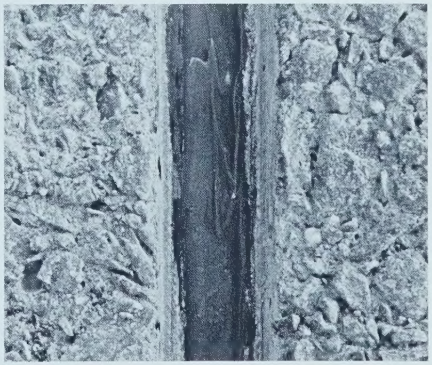
Eliminates periodic sealing . . .

Silicone sealant eases campus maintenance

The cost of periodically resealing buildings and equipment at Southern Illinois University has been greatly reduced by adopting a silicone rubber building sealant as a general purpose caulking material. The changeover from organic type sealants to *Dow Corning* 780 building sealant was made five years ago. This material is now used throughout the 300-building campus at Carbondale, Ill. to form weathertight and watertight seals on masonry, curtain walls, flashing, stone coping, windows, screens, mechanical housings, laboratory countertops and in many other indoor and outdoor applications. In several buildings where leakage was a constant problem, a single application of silicone rubber sealant to joints in the building exteriors corrected the condition. (MN-40)

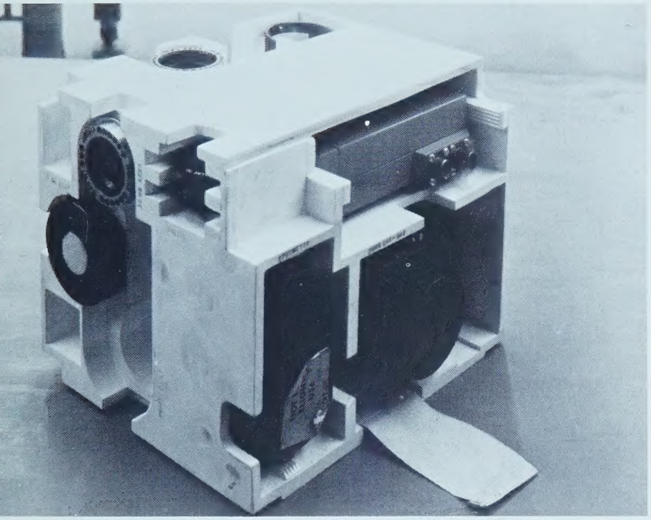


Dried out polysulfide sealant loses its elasticity after several years of sunlight, hot and cold weather cycling on Southern Illinois University campus building. The result is this crazing pattern.



Properly sealed joints, such as this weathertight application of silicone rubber building sealant, have been in service for five years and are expected to last for the life of the building.

Apollo Cushions Soft but Tough



Cameras and other delicate instruments aboard the Apollo spacecraft are stowed in special silicone rubber cushions for maximum protection. (see photo) The cushion material, developed by North American Rockwell's Space Division, is called "Micro-syl". Its composition includes a silicone rubber – *Dow Corning* 93-072 aerospace sealant. The material meets stringent low flammability requirements, is not affected by environmental extremes, does not take a permanent set when loaded, and is easily molded and cut into required shapes. (MN-41)

Continued from page 2

common applications of the functional idea. For example, special, grease-like silicone compounds have been developed to perform as thermal coupling agents. Also, the thermal expansion of a fluorocarbon plastic is being used in place of a solenoid to operate the distribution valve in a hot water system. And in the not-too-distant future, electroluminescence, the conversion of electronic energy to light, using such materials as silicon carbide, should become a practical reality.

The functional materials concept is also making possible many new and unique design approaches. Take, for example, a new shock-absorbing auto bumper in which solid silicone rubber under high impact pressures acts like a highly viscous liquid, and is extruded through openings in a damping head, thus absorbing the impact energy. Afterwards, the stored-up energy causes the rubber to return to its original state and position.

Thus, by realizing that materials can be treated as dynamic systems that react actively with their service environment and that they can be designed as the end products themselves, made to perform the functions of components and mechanisms, we have added a new and expanding dimension to materials technology.

(How the dynamic concept has led to development of "metamorphic" materials will be covered in the next issue.)

Literature for your file

Aircraft maintenance – High performance silicone and fluorosilicone materials used today for commercial aircraft maintenance and overhaul are described in a 12-page brochure. Included is an application guide which details the uses of various adhesives and sealants, protective coatings, encapsulants, rubber, fluids, and lubricants in airframe and engine areas and in electronic, hydraulic and fuel systems, and for tooling purposes. (MN-42)

Silane coupling agents – The concept of chemically promoting the bond between organic and inorganic surfaces by use of silane coupling agents is presented in a comprehensive, 32-page booklet that will serve as a valuable technical reference source. Contents include the functions, chemistry, mechanics, methods of use and applications of silanes in two major categories: filler-and-fibrous-reinforced plastics and elastomers; and bonding problems of adhesives, sealants, resin binders, coatings and miscellaneous composites. (MN-43)

High performance lubricant – The unusual combination of properties and the various uses of *Molykote* Pene-Lube, a new type of lubricant based on white solid lubricants, are described in a new brochure. Applications are listed for the product as a penetrating oil, corrosion preventive medium, extreme pressure lubricant and moisture barrier for metal parts that are made, stored or used in wet, salty or chemically corrosive atmospheres. (MN-44)

Silicone rubber guide – A new 20-page bulletin offers a collection of tables which summarize the requirements of various military and industrial specifications for silicone rubber. The tables also list typical properties of specific *Silastic* rubber stocks or formulations which best meet these requirements. (MN-45)

Pennsylvania first with silicone-alkyd paint specification. See story page 5